

REMARKS

Claims 1-29 and 91-132 are pending. By this Amendment, claims 98-132 are added, and claims 26-29, 91, 93 and 95-97 are amended. No new matter is added by the above amendments.

Applicants thank Examiner Mathews for the courtesies extended to Applicants' undersigned attorney at the August 31 interview. The substance of the interview is detailed below.

I. Description of Claim Amendments

Independent claim 26 has been amended to recite that the illumination optical system includes an optical system (rather than an optical device), and to recite that the optical system changes an annular ratio of an inner diameter to an outer diameter with respect to the annular secondary light source. Independent claims 27 and 28 have been amended to recite that the illumination optical system is disposed on an optical path "of light emitted by a light source so as to illuminate a mask" and includes an optical system disposed in an optical path between the light source and the mask so as to form an annular illumination source, the optical system changing an annular ratio of the annular illumination source. Claim 27 further recites that a variable annular illumination source is formed. The previous last clause of claim 27 also is deleted (although the feature of that clause is now recited in the first clause of 27 as described above). Claim 29 also is amended to recite that the illumination optical system is "disposed in an optical path between a light source and a mask so as to illuminate the mask." The above amendments to claims 26-29 are supported by the original patent at, e.g., col. 5, line 39 - col. 6, line 22, Figs. 6 and 11 and claim 24. In addition, claims 26-29 are amended to recite that the projection optical system is "disposed in an optical path between the mask and a substrate so as to project an image of a mask onto the substrate." This amendment is supported at, e.g., element 10 of Fig. 1. Independent claim 28 is further amended to recite that the projection optical system includes a pupil defining unit disposed

within the projection optical system so as to define a pupil of the projection optical system. This is supported at, e.g., col. 4, lines 43-46 and col. 5, lines 15-24. Claim 29 is further amended to recite an optical system, rather than an optical device, the optical system forming "one of a circular secondary light source and an annular secondary light source selectively based on light from the light source." This is supported at, e.g., Fig. 6.

Claims 91, 93, 95 and 96 are amended to change "optical device" to --optical system-- to be consistent with the above amendments to the independent claims. Claim 97 is amended to correct a typographical informality, namely changing "a pupil plane of the projection optical system" to --a pupil plane of the illumination optical system-- in the last clause thereof.

The subject matter of claims 103 and 113 is supported at, e.g., Figs. 1, 6 and 11, col. 5, line 39 - col. 6, line 22 and claim 24. The subject matter of claims 98 and 129 (plural annular stops that differ from each other) is supported at, e.g., Fig. 6 and col. 5, line 39 - col. 6, line 22. The subject matter of claims 99, 101, 106, 111, 115, 125, 128 and 131 (movable conical elements) is supported at, e.g., col. 7, line 56 - col. 8, line 3. The subject matter of claims 100, 102, 104, 108, 112, 116, 126 and 132 (optical integrator) is supported at, e.g., col. 4, lines 2-7. The features of claims 105, 107, 113, 117, 118, 120 and 121 (pupil changing unit) is supported at, e.g., col. 4, lines 43-46 and col. 5, lines 15-24. The subject matter of claim 109 (annular illumination ratio range) is supported at, e.g., col. 4, lines 19-25 and in the original claims. The features of claims 110, 114, 124 and 130 (high efficiency illumination) is supported at, e.g., col. 7, lines 45-55. The features of claims 119 and 122 is supported at, e.g., col. 2, line 33. The features of claims 123 and 127 (circular and annular illumination) is supported at, e.g., Fig. 6.

II. Information Disclosure Statement

The Examiner is requested to consider the publication entitled "Super-Resolution Lithography (2) Resolution Improvement with Annular Illumination", by K. Tounai et al., and its translation, which are submitted with the attached Information Disclosure Statement.

III. Supplemental Reissue Declaration

A Second Supplemental Reissue Declaration will be filed shortly that addresses the amendments made to the claims in this Amendment, as well as the informalities of the previous Supplemental Reissue Declaration that are identified in the Office Action.

In view of newly added claims 99-102, 106-108, 110-112, 114-119, 124-126, 128 and 130-132, it is necessary to amend the inventorship of this application to add an inventor--Mr. Takashi MORI. The Supplemental Reissue Declaration will be executed by Mr. Mori as well as the other inventors (see 37 C.F.R. §1.48(h), §1.171 and 1.175). *SEE MPEP 1412.04*

Claims 1-29 and 91-97 stand rejected under 35 U.S.C. §251 due to the allegedly defective Reissue Declaration. A Supplemental Reissue Declaration will be submitted shortly in order to overcome this rejection.

IV. The Claims are Patentable over the Applied References

Claims 1-29 and 91-97 stand rejected under 35 U.S.C. §102(e) over U.S. Patent No. 5,627,626 to Inoue et al. This rejection is respectfully traversed.

Attached hereto is a verified translation of the priority document for this application, i.e., Japanese Patent Application No. 3-343601. Since the independent claims of this application are supported by the Japanese priority application, which has a filing date (December 25, 1991) that is prior to the October 15, 1992 U.S. filing date of Inoue et al., Inoue et al. is not available as a reference against the claims of this application. Accordingly, this rejection is moot.

Claim 26 stands rejected under 35 U.S.C. §103(a) over JP-A-61-91662 in view of either U.S. Patent No. 5,489,966 to Kawashima et al., U.S. Patent No. 5,168,157 to Kimura, or U.S. Patent No. 4,902,115 to Takahashi. These rejections are respectfully traversed.

As recognized in the Office Action, JP-61-91662 does not disclose or suggest the relationship between the inner and outer diameters of the annular secondary light source recited in claim 26. Applicants respectfully submit that none of the secondary references relied upon in the Office Action (i.e., Kawashima et al., Kimura and Takahashi) discloses or suggests this claimed relationship. While these references, like JP-61-91662, disclose annular secondary light sources, no explicit relationship between inner and outer diameters is disclosed or suggested in the secondary references.

Moreover, Applicants respectfully submit that none of the references discloses or suggests the combinations of features recited in the independent claims of this application. For example, none of the references discloses or suggests the claimed range for the ratio between the inner and outer diameters of the annular illumination recited in independent claims 1, 12 and 21-26. Additionally, none of the references discloses or suggests an optical system that changes the annular illumination ratio (i.e., that varies an annular illumination ratio) as recited in independent claims 24, 26-29, 97, 103 and 113. JP-61-91662, Kawashima et al., Kimura and Takahashi only disclose a single annular stop. This annular stop is not variable. In addition, as noted above with respect to independent claim 26, these references do not disclose or suggest any relationship between the inner and outer diameters of the annular illumination. See, for example: col. 18, lines 11-20 and col. 18, lines 33-40 of Kawashima et al.; col. 15, lines 9-13 and col. 15, lines 29-53 of Kimura; and col. 3, lines 60-68 and col. 4, line 6 - col. 5, line 37 of Takahashi. Takahashi provides either a large circular illumination (Fig. 6F), a small circular illumination (Fig. 6D), or a single annular illumination (Fig 6B).


The newly submitted abstract to Tounai et al. also does not disclose or suggest the above-noted features of the independent claims. Tounai et al. describes testing that was done regarding annular illumination. In particular, values for the ratio between the inner and outer diameters of the annular illumination that were used were 0.7 and 0.9. Tounai et al. states that "the larger ϕ_i is, the better it is." Thus, Tounai et al. discloses values that are larger than the range recited in claims 1, 12 and 21-26, and suggests using larger values rather than smaller values. In addition, Tounai et al. does not disclose or suggest providing structure that varies or changes the annular ratio as recited in independent claims 24, 26-29, 97, 103 and 113.

V. Conclusion

In view of the foregoing, Applicants respectfully submit that this application is in condition for allowance. Favorable consideration and prompt allowance are earnestly solicited.

Should the Examiner believe anything further would be desirable to place this application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,



James A. Oliff
Registration No. 27,075

Mario A. Costantino
Registration No. 33,565

JAO:MAC/ms

Attachments:

Petition for Extension of Time
Information Disclosure Statement
Verified Translation of Japanese Pat. Appl. 3-343601

Date: September 4, 2001

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

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